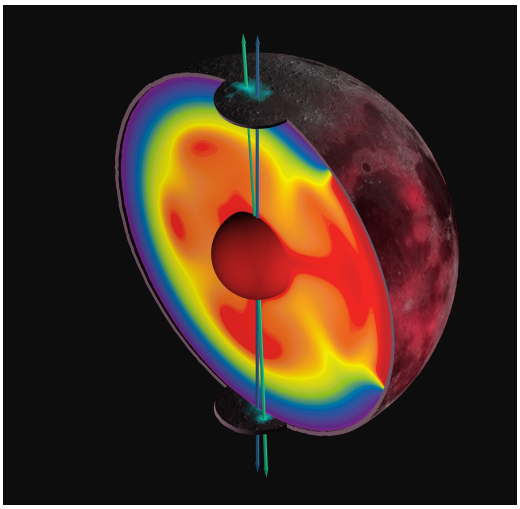
Space Science Seminar
Tuesday, 2016 June 7
10:30 a.m.
NSSTC/2096

Lunar True Polar Wander Inferred from Polar Hydrogen



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Host: Dr. Renee Weber (sponsored by ZP13)

The earliest dynamic and thermal history of the Moon is not well understood. The hydrogen content of deposits near the lunar poles provides insight into this history, because these deposits (which are probably composed of water ice) survive only if they remain in permanent shadow. If the orientation of the Moon has changed, then the locations of the shadowed regions will also have changed. The polar hydrogen deposits have been mapped by orbiting neutron spectrometers, and their observed spatial distribution does not match the expected distribution of water ice inferred from present-day lunar temperatures. Here we show that polar hydrogen preserves evidence that the spin axis of the Moon has shifted: the hydrogen deposits are antipodal and displaced equally from each pole along opposite longitudes. From the direction and magnitude of the inferred reorientation, and from analysis of the moments of inertia of the Moon, we hypothesize that this change in the spin axis, known as true polar wander, was caused by a low-density thermal anomaly beneath the Procellarum region. Radiogenic heating within this region resulted in the bulk of lunar mare volcanism and altered the density structure of the Moon, changing its moments of inertia. This resulted in true polar wander consistent with the observed remnant polar hydrogen. This thermal anomaly still exists and, in part, controls the current orientation of the Moon. Our hypothesis provides an explanation for the antipodal distribution of lunar polar hydrogen, suggests a significant fraction of the measured polar hydrogen is ancient, and connects polar volatiles to the geologic and geophysical evolution of the Moon and the bombardment history of the early Solar System.

http://solarscience.msfc.nasa.gov/colloquia/